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Development of Web-Based Learning Media for Teaching Trigonometric Ratios to Grade X Students

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Abstract

Teaching trigonometric ratios remains challenging because students often struggle with abstract concepts, conventional instruction predominates, and digital learning resources are underused. This study developed a Google Sites learning resource for teaching trigonometric ratios to tenth-grade students at MAS TI Batang Kabung and evaluated its validity and practicality. The study followed the 4D development model (Define, Design, Develop, and Disseminate) and involved one mathematics teacher and 25 tenth-grade students in a product trial. Data were collected through observations, interviews, documentation, and validation and practicality questionnaires, then analyzed using descriptive quantitative and qualitative techniques. Expert validation scores for content and media were 91.07% and 92.11%, respectively, both classified as highly valid. Practicality scores were 93.42% from the teacher and 86.26% from the students, yielding an overall mean of 89.84%, classified as highly practical. The resource brings together instructional materials, illustrations, videos, exercises, and assessments on a single website. The validity and practicality ratings support its use as a structured digital resource for teachers and students that offers flexible access to trigonometry materials and activities.

Keywords: Google Sites; Trigonometric Ratios; 4D Development Model; Web-Based Learning; Mathematics Education

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INTRODUCTION

Mathematics education plays a strategic role in developing students' logical, critical, analytical, and systematic thinking skills, as well as their problem-solving abilities. Beyond computational proficiency, mathematics aims to foster conceptual understanding, reasoning, and the application of knowledge in everyday contexts. Therefore, instruction should be systematically designed to promote meaningful understanding rather than rote memorization. These objectives align with twenty-first-century education, which emphasizes critical thinking, creativity, communication, collaboration, and digital technology integration (Maulida et al., 2025).

Advances in information and communication technology have created opportunities for more innovative, interactive, and flexible learning through digital media that support content exploration, concept visualization, independent practice, and assessment. Pagarra et al. (2022) emphasize that instructional media play an essential role in facilitating the delivery and comprehension of learning materials. Thus, digital learning media offer a strategic alternative to conventional instruction, which often relies on verbal explanations and printed materials.

Digital media are particularly important in mathematics education because abstract concepts often require visualization and representation to facilitate understanding. Integrating text, images, videos, animations, and interactive exercises can help students develop structured conceptual understanding. Supporting this, Schoenherr et al. (2024), through a meta-analysis of 41 studies involving 10,562 students, found that mathematical visualization positively influences learning outcomes, highlighting its relevance in enhancing students' conceptual understanding.

These issues have also been identified in Grade X mathematics instruction at MAS TI Batang Kabung. Based on preliminary interviews with the mathematics teacher, as documented in the research records, the learning process was found to remain predominantly conventional. The teacher typically explains the material, writes formulas on the board, and subsequently assigns exercises to students. The instructional media currently used are still limited to printed textbooks, while the integration of web-based digital learning media has not been optimally implemented. The teacher also reported time constraints in preparing instructional media and the lack of specialized training in developing digital learning media.

These conditions indicate challenges in utilizing technology to support mathematics instruction. Nevertheless, based on preliminary information, MAS TI Batang Kabung is equipped with a computer laboratory and Wi-Fi network that could be utilized to support digital learning. Therefore, the challenges encountered are not solely related to limitations in facilities and infrastructure but also involve the suboptimal development and utilization of instructional media that address students' learning needs. The researcher considers that these conditions require a practical solution that is easy for teachers to use, accessible to students, and capable of presenting mathematical content in a more engaging and systematic manner.

These instructional challenges become particularly significant when considered in relation to the topic of Trigonometric Ratios. This topic is one of the mathematics subject areas taught in Grade X and requires students to understand the relationship between angles and side lengths in right-angled triangles. Students are expected not only to master the sine, cosine, and tangent formulas but also to identify the opposite, adjacent, and hypotenuse sides relative to a given angle. Difficulties in understanding these geometric relationships may hinder students when solving problems involving different forms and contexts.

Research by Fauziah and Puspitasari (2022) indicates that learning trigonometry presents particular challenges because students are required to understand abstract concepts and establish connections between symbolic and geometric representations. Similarly, Sugianto et al. (2023) identified that difficulties in learning trigonometry are associated with students' abilities to understand and visualize the relationships among the components of trigonometric concepts. These issues suggest that trigonometry instruction requires learning media that do not merely present formulas but also provide visual illustrations, step-by-step explanations, practical examples, and exercises to help students develop their conceptual understanding progressively.

Based on these conditions, the researcher considers the development of web-based learning media to be a relevant alternative for addressing the limitations of mathematics instruction at MAS TI Batang Kabung. Web-based media enable learning materials to be presented through an integrated digital platform incorporating various learning resources, such as texts, images, instructional videos, worked examples, and assessments. Furthermore, students can access learning materials more flexibly through internet-connected devices. Accordingly, the development of web-based learning media is expected to support a more independent and engaging learning process that better addresses students' learning needs.

Previous studies have demonstrated the potential of Google Sites and web-based media in supporting mathematics education. Salsabila and Aslam (2022) developed Google Sites-based media for elementary science learning, while Susanti and Fitriani (2023) examined its potential for mathematics instruction through preliminary analysis. Arnisya et al. (2024) developed Google Sites-based mathematics media using the ADDIE model for Systems of Linear Equations in Two Variables, whereas Muhammad et al. (2025) integrated web-based media with the Realistic Mathematics Education approach for Linear Inequalities in One Variable. Similarly, Dewi and Rusmining (2025) developed Google Sites-based media incorporating mathematical literacy for Relations and Functions among Grade VIII students. Although these studies highlight the potential of digital media to support mathematics learning, their subject matter, educational levels, and development focuses differ from the needs of Grade X students learning Trigonometric Ratios. Therefore, further research is needed to develop Google Sites-based learning media specifically designed to address the conceptual and visualization requirements of this topic at the Islamic senior high school level.

Based on the aforementioned studies, it can be concluded that the use of Google Sites in mathematics instruction has been investigated across various subject areas, educational levels, and instructional approaches. Nevertheless, there remains an opportunity for more specific development, namely the development of Google Sites-based web learning media tailored to the characteristics of Trigonometric Ratios for Grade X students at MAS TI Batang Kabung. This research gap does not imply that Google Sites has never been used in mathematics instruction. Rather, it lies in the differences in subject matter characteristics, target users, educational institutional contexts, and the specific requirements for presenting instructional content.

The novelty of this study lies in the development of Google Sites-based web learning media specifically designed to address the characteristics of the Trigonometric Ratios topic and the learning needs of Grade X students at MAS TI Batang Kabung. Unlike previous studies that developed Google Sites-based media for topics such as Relations and Functions, Systems of Linear Equations in Two Variables, and Linear Inequalities in One Variable, this study focuses on presenting trigonometric concepts that require connections among symbolic, numerical, and geometric visual representations.

Theoretically, the development of web-based learning media in this study is grounded in instructional media theory and the principles of multimedia learning. Instructional media

refer to tools used to convey instructional information or messages in ways that stimulate students' attention, interest, thinking, and engagement in the learning process. The appropriate use of media can help teachers present learning materials more systematically while facilitating students' understanding of the information being delivered (Pagarra et al., 2022).

The theoretical foundation of this study includes multimedia learning principles, Cognitive Load Theory, and web-based learning. Multimedia learning emphasizes combining words and images to support understanding, particularly in mathematics, where students need to connect verbal, visual, and symbolic representations. In teaching Trigonometric Ratios, right-triangle illustrations can clarify the relationships between angles and side lengths, as supported by Xonkulov et al. (2026), who highlighted the role of visual representations in understanding trigonometric concepts. Furthermore, Cognitive Load Theory emphasizes the limited capacity of working memory, suggesting that instructional materials should be structured and presented gradually through concise explanations, illustrations, worked examples, and exercises. Ngu et al. (2026) reinforced the importance of guided instruction and worked examples in reducing cognitive load when solving complex trigonometric problems. Finally, web-based learning provides an integrated and accessible digital learning environment. Google Sites was selected for its ability to organize instructional content and integrate digital resources, supported by Susanti and Fitriani (2023) and Arnisya et al. (2025), who demonstrated its potential as a practical platform for mathematics learning media.

Based on the problem statement, findings from previous studies, identified research gaps, and theoretical foundations discussed above, this study focuses on the development of Google Sites-based web learning media for the Mathematics subject, specifically the topic of Trigonometric Ratios, for Grade X students at MAS TI Batang Kabung. The development process encompasses an analysis of instructional needs, the design of the media structure and content, product development, and an assessment of media quality in terms of validity, practicality, and effectiveness, provided that effectiveness is included in the research evaluation design.

Accordingly, this study is expected to provide practical contributions to teachers by offering an innovative and user-friendly alternative for mathematics instruction, while providing students with a more engaging and flexible learning experience. Academically, this

study is expected to enrich research on the development of digital learning media, particularly the utilization of Google Sites in mathematics education for subject matter that requires visual representations and conceptual understanding.

METHODS

This study employed a Research and Development (R&D) method aimed at developing Google Sites-based web learning media for the topic of Trigonometric Ratios for Grade X students at MAS TI Batang Kabung. The development model adopted was the 4D (Four-D) Model proposed by Thiagarajan et al. (1974), which consists of four stages: Define, Design, Develop, and Disseminate. This model was selected because it provides a systematic development procedure, ranging from the identification of instructional needs to product evaluation and dissemination. This study focused on assessing the validity and practicality of the developed learning media.

The development procedure was carried out through four stages. The Define stage involved analyzing instructional needs, the curriculum, student characteristics, learning materials, and instructional objectives to identify existing problems and the requirements for developing learning media. The Design stage involved formulating instructional objectives, organizing the learning materials, and preparing the storyboard, flowchart, and initial media design using Google Sites with the support of Canva. The Develop stage included product development, validation by subject matter and media experts, revisions based on the validators' recommendations, and practicality testing involving the teacher and students. Subsequently, the Disseminate stage involved the limited distribution of the product within MAS TI Batang Kabung. Therefore, dissemination was not conducted on a broader scale.

The research participants consisted of a subject matter expert validator, two media expert validators, one mathematics teacher, and 25 Grade X students at MAS TI Batang Kabung. Participants were purposively selected based on their expertise and relevance to the product development process. The subject matter expert was responsible for evaluating content relevance, conceptual accuracy, material presentation, and language use. The media experts assessed the visual appearance, design, navigation, and technical feasibility of the product. Meanwhile, the teacher and students participated in the practicality testing to evaluate the ease of use, visual presentation, content relevance, and usefulness of the media in the learning process.

Data were collected through observation, interviews, documentation, and questionnaires. Observation was conducted to identify the existing instructional conditions, the use of learning media, and the availability of supporting facilities. Unstructured interviews with the mathematics teacher were conducted to obtain information regarding instructional needs and existing learning problems. Documentation included photographs of research activities, validation documents, and summaries of questionnaire results. Furthermore, subject matter and media expert validation questionnaires were used to assess product feasibility, while teacher and student response questionnaires were administered to measure the practicality of the developed media. All questionnaires employed a four-point Likert scale. The collected data comprised qualitative data in the form of comments and suggestions for improvement, as well as quantitative data consisting of assessment scores provided by validators and respondents.

The data were analyzed using qualitative and quantitative descriptive techniques. Qualitative analysis involved data reduction, data presentation, and conclusion drawing based on observations, interviews, and feedback from validators and respondents. Meanwhile, quantitative analysis was conducted by calculating the percentage scores of product validity and practicality. The resulting percentages were then interpreted using the criteria adapted from Akbar (2013), as follows: 81–100% (very valid/very practical), 61–80% (valid/practical), 41–60% (moderately valid/moderately practical), 21–40% (less valid/less practical), and 0–20% (invalid/not practical). The learning media were considered to meet the validity and practicality criteria if they achieved a minimum percentage score of 81%.

RESULTS

1. Results of Learning Media Development

The developed product is web-based learning media that integrates Google Sites and Canva to present instructional materials and visual elements. The media are equipped with illustrations, instructional videos, practice questions, and interactive assessments using Kahoot. The final product consists of eight main pages: the home page, user guide, learning outcomes and objectives, basic concepts, formulas and illustrations, instructional videos, exercises, and assessment. All pages are interconnected through navigation features, enabling students to access the materials systematically using an internet-connected computer, laptop, or smartphone.

During the development stage, the materials were organized based on the Mathematics Learning Outcomes for Phase E, covering trigonometric ratios in right triangles, trigonometric ratios of special angles, Cartesian coordinates and quadrants, and related angles. The product was subsequently validated by subject matter and media experts before being tested with the teacher and students.

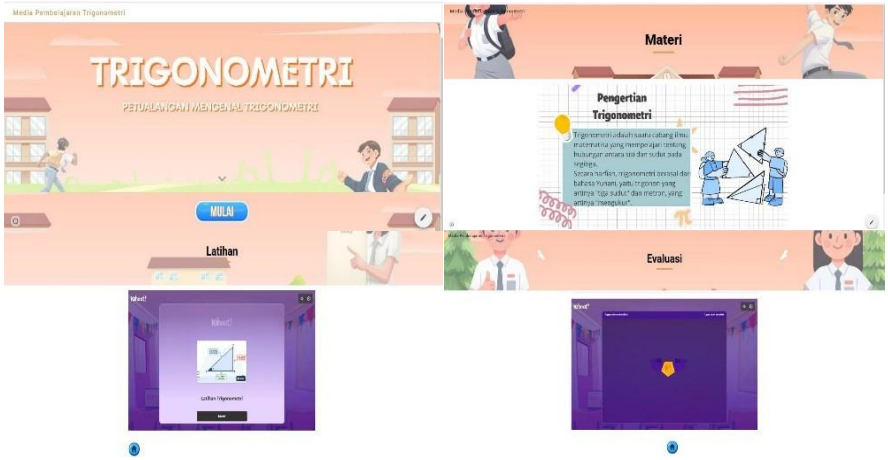

Figure 1. Google Sites for Teaching Trigonometric Ratios

2. Results of Subject Matter Expert Validation

Subject matter expert validation was conducted to assess the content feasibility of the learning media based on four aspects: content alignment, material feasibility, instructional support, and language. The assessment instrument consisted of 14 statement items, with a maximum score of 56.

Table 1. Results of Subject Matter Expert Validation

No.	Assessment Aspect	Percentage	Category
1	Content Alignment	91.67%	Very Valid
2	Material Feasibility	90.00%	Very Valid
3	Instructional Support	87.50%	Very Valid
4	Language	93.75%	Very Valid
	Overall Average	91.07%	Very Valid

The validation results on table 1 showed that the media obtained a score of 51, equivalent to 91.07%, and were therefore classified as very valid. In greater detail, the language aspect achieved the highest percentage at 93.75%, followed by content alignment at 91.67%, material feasibility at 90.00%, and instructional support at 87.50%. These results indicate that the developed materials meet the requirements for curriculum alignment, mathematical conceptual accuracy, systematic presentation, and language readability for Grade X students.

3. Results of Media Expert Validation

Media validation was conducted by two validators to evaluate product quality across five aspects: appearance or presentation, visual and graphic design, navigation and ease of use, media presentation, and technical aspects.

Table 2. Results of Media Expert Validation

No.	Assessment Aspect	Percentage
1	Appearance/Presentation	90.63%
2	Visual and Graphic Design	92.50 %
3	Navigation and Ease of Use	93.75%
4	Media Presentation	95.83%
5	Technical Aspects	87.50%
Overall Validation		92.11%

The results on table 2 showed that the first validator awarded a score of 75 out of 76, equivalent to 98.68%, while the second validator awarded a score of 65 out of 76, equivalent to 85.53%. Based on the combined assessments of both validators, the overall validity percentage was 92.11%, which falls into the very valid category. The media presentation aspect achieved the highest percentage at 95.83%, whereas the technical aspect recorded the lowest percentage at 87.50%. These findings indicate that the product meets most of the feasibility criteria concerning appearance, navigation, presentation, and the technical functionality of the learning media.

4. Results of the Practicality Test

The practicality test was conducted to determine the ease of use and feasibility of the learning media based on the assessments of one mathematics teacher and 25 Grade X students at MAS TI Batang Kabung. The assessment covered four aspects: ease of use, appearance, content or materials, and the benefits or impact of the learning media.

Table 3. Results of the Teacher and Student Practicality Test

No.	Assessment Aspect	Teacher	Students	Average
1	Ease of Use	93.75%	87.00%	90.38%
2	Appearance	93.75%	85.75%	89.75%
3	Content/Materials	93.75%	86.25%	90.00%
4	Benefits/Impact	92.86%	86.14%	89.50%
Overall		93.42%	86.26%	89.84%

Based on table 3 the mathematics teacher's assessment, the media achieved a practicality percentage of 93.42%, which falls into the very practical category. The aspects of ease of use, appearance, and content or materials each obtained 93.75%, while the benefits

or impact aspect achieved 92.86%. Meanwhile, the assessments provided by the 25 students resulted in a percentage of 86.26%, also classified as very practical. In detail, ease of use obtained 87.00%, appearance 85.75%, content or materials 86.25%, and benefits or impact 86.14%.

The teacher's and students' assessment results were combined by assigning equal weights to both respondent groups. The resulting overall average practicality percentage was 89.84%, which falls into the very practical category. Based on the assessment aspects, ease of use achieved an average of 90.38%, appearance 89.75%, content or materials 90.00%, and benefits or impact 89.50%. All aspects were classified as very practical.

In addition to the validity and practicality assessments, this study identified several product components that required further improvement. Feedback from the media validators included recommendations to improve the appearance of the home page, adjust font sizes and types, enhance text-to-background contrast, correct technical errors, and refine the layout and menu design. The validators also suggested that the material presentation should not resemble a conventional textbook too closely and should incorporate more engaging visual variations. All feedback was used as the basis for revisions before the product was tested with the students.

Other findings indicated that, although the overall media expert validation result reached 92.11%, one menu layout indicator obtained a percentage of 75.00%. In addition, the technical aspect recorded the lowest percentage among the media validation aspects, at 87.50%. In the student practicality test, the appearance aspect also received the lowest score compared with the other aspects, at 85.75%. Nevertheless, all these results remained within the very valid or very practical categories, according to the respective types of assessment. The revision and testing results indicate that the final product meets the validity and practicality criteria for use as a supporting learning medium for Trigonometric Ratios.

DISCUSSION

The results indicate that the development of Google Sites-based web learning media for the topic of Trigonometric Ratios for Grade X students at MAS TI Batang Kabung successfully produced a learning product that met the criteria of very valid and very practical. The validity level based on the subject matter expert's assessment reached 91.07%, while the media expert validation result was 92.11%. Meanwhile, the practicality test yielded percentages of 93.42% based on the teacher's assessment and 86.26% based on the students'

assessments, with a combined average of 89.84%. These findings indicate that the developed product meets the criteria for content feasibility, material presentation, visual design, ease of use, and usefulness as a supporting medium for mathematics learning.

The high subject matter validation score indicates that the instructional content was developed in accordance with the learning objectives, curriculum, characteristics of the subject matter, and Grade X students' level of understanding. The Trigonometric Ratios materials were systematically presented by integrating concepts, formulas, illustrations, instructional videos, and practice questions. This integration is important because trigonometry involves abstract mathematical concepts and requires visual representations to help students understand the relationships among mathematical elements. Meanwhile, the media expert validation results indicate that the product's design and presentation meet most of the feasibility criteria for digital learning media. The use of Google Sites as the primary platform, supported by Canva, instructional videos, and Kahoot, enables various learning resources to be presented within a structured learning environment.

The practicality test results also indicate that the media were well received by both the teacher and students. The teacher practicality percentage of 93.42% indicates that the media were considered easy to use and capable of assisting the teacher in delivering instructional materials. Meanwhile, the student practicality percentage of 86.26% indicates that the media can serve as an alternative learning resource. The difference between the teacher's and students' assessments reflects their different user perspectives. The teacher tended to evaluate the media based on their suitability for instructional delivery, whereas students interacted more directly with aspects of appearance, navigation, and ease of content access. Nevertheless, both groups rated the media as very practical.

One finding that deserves attention is that the appearance aspect in the students' assessment obtained a percentage of 85.75%, which was lower than the other aspects. In addition, one menu layout indicator in the media validation received a score of 75%. These results suggest that high content quality and comprehensive features do not automatically guarantee an optimal user experience. Interface design, navigation consistency, font size, and visual consistency remain important considerations in developing digital learning media. Therefore, the validators' suggestions regarding improvements to the home page, font types and sizes, color contrast, and menu layout were important components of the product revision process. Overall, these findings demonstrate that media development should not

focus solely on content completeness but should also consider user comfort and ease of interaction.

The findings of this study are consistent with several previous studies that developed Google Sites-based learning media. Husin Saputra, Octaria, and Isroqmi (2022), in their study on the development of Google Sites-based web learning media for the topic of Derivatives of Functions, reported a validity level of 85.3%, categorized as very valid, and student responses in the very practical category. These results are consistent with the present study, which obtained subject matter validity of 91.07% and media validity of 92.11%. Both studies share the use of Google Sites as a web-based mathematics learning medium. However, they differ in terms of subject matter, educational level, and development model. The previous study focused on Derivatives of Functions for Grade XI students using the ADDIE model, whereas the present study developed materials on Trigonometric Ratios for Grade X students using the 4D model.

The findings of this study can also be compared with those of Syah, Syarifudin, and Hidayatullah (2024) who developed interactive Google Sites learning media to improve learning outcomes among vocational high school students. Their study reported a feasibility level of 87.49%, a student response rate of 88.73%, and an N-Gain score of 56.24%, categorized as moderately effective. The present study shares similarities in its use of Google Sites and its focus on Grade X students. However, Syah et al. developed media for the subject of Basic Mechanical Engineering and measured learning effectiveness, whereas the present study focused on mathematics learning, specifically Trigonometric Ratios, and evaluated product validity and practicality. This difference highlights the contribution of the present study in applying Google Sites to present abstract mathematical concepts through the integration of text, illustrations, videos, exercises, and assessments within a single platform.

Furthermore, Veranita and Setyadi (2021) developed Mathjong Trigonometry learning media using the Research and Development method and the ADDIE model. Their study focused on developing trigonometry learning media that met the criteria of validity, practicality, and effectiveness. The similarity with the present study lies in the focus on trigonometry and the use of a development research approach. The difference lies in the characteristics of the products: an educational game called Mathjong in the previous study and Google Sites-based web learning media in the present study. This distinction

demonstrates that trigonometry learning media can be developed through various technological formats and presentation approaches.

In addition, Sari, Suharta, and Parwati (2025) developed interactive electronic student worksheets (E-LKPD) based on Problem-Based Learning for Grade X trigonometry. Their study showed that the developed product met the criteria of validity, practicality, and effectiveness in improving students' mathematical problem-solving skills. Compared with that study, the present research shares the same subject matter and target grade level but differs in the type of media and evaluation focus. The present study developed a Google Sites-based learning portal that integrates various learning resources, whereas Sari et al. focused on electronic worksheets based on Problem-Based Learning.

Based on these comparisons, the contribution of the present study lies in the development of Google Sites-based web learning media specifically designed for Grade X Trigonometric Ratios by integrating instructional materials, illustrations, videos, exercises, and assessments within a single platform. The novelty of this study does not lie in the use of Google Sites as an entirely new technology, but rather in its application context, subject matter characteristics, integration of instructional components, and product evaluation in terms of validity and practicality at MAS TI Batang Kabung.

The findings of this study have theoretical and practical implications for the development of technology-based mathematics learning media. Theoretically, the results provide insight into how integrating various content presentation formats within a single platform can serve as an alternative for supporting the learning of abstract mathematical concepts. Media that combine text, illustrations, videos, exercises, and assessments provide students with varied learning experiences. This is related to Edgar Dale's Cone of Experience, which emphasizes the importance of diverse experiences in the learning process. In the context of this study, varied material presentations allow students to obtain information not only through textual explanations but also through visual and audiovisual representations. However, this implication serves as a conceptual foundation for media development rather than empirical evidence that the media improve learning outcomes.

Practically, this study provides teachers with an alternative for developing more varied mathematics instruction. Google Sites-based media can be used to present materials systematically without requiring teachers to possess specialized programming skills. The integration of Canva, instructional videos, and Kahoot also provides flexibility in organizing

instructional content and learning activities. For students, the media provide an additional learning resource that can be used to access materials, review Trigonometric Ratios concepts, watch instructional videos, and complete exercises and assessments. For schools, the findings can serve as a consideration for optimizing the use of computer laboratories and Wi-Fi networks to support digital learning. Thus, the developed product has the potential to serve as an alternative supporting medium that teachers and students can use according to their instructional needs.

Although the study achieved validity and practicality results in the very high categories, several limitations should be considered. First, the developed product focused exclusively on the topic of Trigonometric Ratios for Grade X students. Therefore, its application to other mathematics topics would require adjustments to accommodate the characteristics of the subject matter and the learning objectives. Second, product testing was conducted at only one educational institution, namely MAS TI Batang Kabung, involving one mathematics teacher and 25 students. Consequently, the findings cannot yet be generalized broadly to schools with different student characteristics, facilities, and instructional conditions.

Third, this study only assessed product validity and practicality; therefore, it did not provide empirical evidence regarding the effectiveness of the media in improving students' learning outcomes, motivation, or mathematical problem-solving skills. Effectiveness testing requires further research using an experimental or quasi-experimental design involving measurements of learning outcomes before and after media implementation. Fourth, the dissemination stage of the 4D model was not conducted on a broad scale and remained limited to the MAS TI Batang Kabung environment. Fifth, the use of Google Sites depends on device availability and a stable internet connection. These conditions may limit access when students are in environments with inadequate technological facilities and network connectivity. Another limitation concerns the user interface design, particularly the menu layout and visual appearance, which still require refinement based on feedback from the validators and student responses.

Considering these limitations, future research is recommended to test the media in schools with more diverse characteristics, expand the range of instructional materials, and evaluate its effectiveness using an experimental design. Further development could also focus on optimizing the interface, navigation, and accessibility to enable broader use of the media.

In this way, the development of web-based learning media would not only produce valid and practical products but could also provide empirical evidence of their contribution to the quality of mathematics learning processes and outcomes.

CONCLUSION

This study successfully developed Google Sites-based web learning media for the topic of Trigonometric Ratios for Grade X students at MAS TI Batang Kabung using the 4D development model (*Define, Design, Develop,* and *Disseminate*). The evaluation results showed that the media achieved validity scores of 91.07% from the subject matter expert and 92.11% from the media experts, both of which were categorized as very valid. Meanwhile, the practicality test yielded scores of 93.42% based on the teacher's assessment and 86.26% based on the students' assessments, with an overall average of 89.84%, categorized as very practical. These results indicate that the developed media meet the validity and practicality criteria for use as a supporting medium for teaching Trigonometric Ratios.

The contribution of this study lies in the development of web-based mathematics learning media that integrate instructional materials, visual illustrations, instructional videos, practice questions, and interactive assessments within a single digital platform. This development provides an alternative learning resource that is systematically organized and flexibly accessible to both teachers and students. Future research is recommended to examine the effectiveness of the media through experimental or quasi-experimental designs, extend its application to other mathematics topics and schools with different characteristics, and further optimize the media's user interface and accessibility. Thus, subsequent studies can provide more comprehensive empirical evidence regarding the contribution of web-based learning media to improving the quality of mathematics education.

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